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*Guidelines for MUSE may be viewed **HERE***

Name

MU ID#
M0088338

Local Address

Major
Psychology

CGPA Overall
3.92

CGPA in Major
4.0

FACULTY SPONSOR INFORMATION

Faculty Sponsor

Faculty Spoonsor Department
Psychology

Field Course(s) desired

Location(s)

PROJECT INFORMATION

Project Title

The Effects of Environmental Enrichment on Economic Demand for and Reinstatement of Ethanol-Seeking in Female Rats

Project Narrative

1. Student Statement: Upon graduating from Millersville University, I intend to pursue a career as a research psychologist in the field of drug addiction, which will require a PhD. In order to gain research experience, I have been working closely with a mentor (Dr. Kelly Banna) on designing and carrying out a Senior Honors Thesis. We expect data collection to begin this spring and continue through the end of August. If I am awarded an MU-MUSE grant, I will be able to spend the summer collecting data for and writing my thesis instead of working full-time, which is how I typically finance my college education.

Qualifications: My preparation for this project includes successful completion of relevant coursework, including Statistics & Experimental Design I & II, Introduction to Learning and Behavior Analysis, and the Advanced Laboratory in Learning and Behavior Analysis (which includes a rat lab component); serving as a research assistant in the rat lab since Fall 2016; and participation in the Psychology Department Honors Program (beginning Fall 2017).

Interest: Within the field of drug addiction, I am particularly interested in the effect of environmental factors on drug addiction and relapse. Animal models, such as the one described below, allow for the identification of cause-effect relations though experimental manipulation of these factors, which is not ethically possible in humans.

2. Project Narrative: While increases in illegal opiate use and overdose has garnered much media attention in recent years, Americans continue to struggle with a variety of addiction disorders. In 2015, for example, 138.3 million Americans (12 years of age or older) reported using alcohol over the previous 30 days (SAMHSA, 2016). Approximately 48.2% (66.7 million) of this group reported binge drinking, and 12.5% (17.3 million) reported heavy alcohol use1. In addition, 20.8 million people reported being diagnosed with a substance use disorder (SUD) within the past year, of which 15.7 million (75.6%) reported alcohol use disorder. These figures indicate that 1 in 17 Americans aged 12 or older face significant alcohol-related impairments. While decades of research have yielded progress in the characterization and treatment of alcohol addiction, these statistics clearly indicate that there is more work to be done.

Because drug research in human populations is, to a large extent, correlational in nature, much of what we know about substance abuse and relapse is derived from experimental animal research. Such studies allow us to identify causal links among initiation of and relapse to substance abuse and other factors, a task that would be unethical to pursue in human populations. In the 1970s, the operant self-administration paradigm was developed to model substance use/abuse and relapse in humans (see Venniro et al. [2016] for a review). In the self-administration model, animals (usually rodents) are trained to respond (e.g., press a lever) in order to earn access to a drug (e.g., a small amount of alcohol, an IV infusion of heroin). After a period of several days to several weeks, responding is extinguished by allowing the animal to continue to make the response, but drug delivery is discontinued. Response rates decrease to relatively low levels during this period. Reinstatement (relapse) testing is then conducted to determine whether various factors (e.g., small amounts of the drug, drug-paired cues, or stress) can induce relapse to drug seeking as evidenced by an increase in responding over extinction levels.

This model has been invaluable in identifying both the neural mechanisms and environmental factors responsible for substance use/relapse among humans. For example, studies have shown that environmental enrichment in rats decreases consumption of alcohol in alcohol-preferring rats (Deehan et al., 2011), reduces cue-induced reinstatement of methamphetamine seeking (Hofford, et al., 2014), and decreases cocaine self-administration and cue- and stress-induced cocaine reinstatement (Chauvet et al., 2009).

The present study will use methods described by Banna et al. (2010) and Galuska et al. (2011) to determine if environmental enrichment influences the reward value of alcohol in rats as assessed by a) self-administration of alcohol, b) relapse, and c) economic demand for alcohol.

Method

Subjects: Subjects will include 16 female rats obtained between 20 and 30 days old. Upon arrival, rats will be placed into one of two housing conditions (see below). Animals will be fed to maintain a bodyweight of 240 grams. Water will be available freely and without restriction in home cages throughout the study.

Subjects will be housed in one of two conditions: standard or enriched. Those in the standard condition will be housed individually in standard polycarbonate cages containing aspen bedding. Animals in the enriched condition will be group housed (four per cage) in wire, multi-level cages (76.2 x 45.7 x 91.4 cm) which will be lined with fleece. Subjects will be provided with species - appropriate toys and chews, half of which will be rotated daily.

Apparatus and Materials: All experimental sessions will be conducted in standard operant chambers. Each chamber will be equipped with a houselight, ventilation fan, two retractable levers, two cue lights, a tone generator, and a food/liquid dispenser. All experimental events will be controlled and recorded using MedPC IV software running on a PC located in the experimental room.

Procedure: Animals will be trained to press a lever for alcohol rewards using a procedure modified from Simms et al. (2010). After responding for alcohol is established, the reward value of alcohol will be assessed using a procedure called demand analysis. In demand analysis, the number of lever-presses required to achieve an alcohol reward is systematically increased over the course of several days. After the demand analysis is conducted, the animals will self-administer alcohol during daily, 30-60 min. sessions for 14-26 days. After this extended period of self-administration, a second demand analysis will be conducted to determine if continuous alcohol consumption affects the reward value of alcohol and whether this effect is mediated by housing condition.

Following the second demand analysis, responding will be extinguished by allowing the animals to continue lever pressing, but discontinuing alcohol delivery. When rewards are withheld, lever-pressing tends to decrease over time. We will then conduct relapse testing. During testing, responding will not result in any alcohol rewards, similar to the extinction sessions. We will assess relapse by presenting three factors that are associated with relapse in humans in three separate relapse tests. These factors are: a) a small dose of passively-administered alcohol, b) cues that were associated with alcohol administration, and c) stress.

We will evaluate the effects of environment on alcohol reward efficacy by comparing the enriched to the standard group on the following measures: a) response rates during self-administration, b) change in demand (pre- v. post- continuous access, and c) response rates during relapse testing.

Learning plan: The project described herein falls entirely within the realm of Dr. Banna's expertise and research agenda (see above). We have been working together closely to develop this project since spring of 2017, meeting weekly and more often, when needed. The primary objective is to learn how to model human substance abuse and relapse in animals using the well-established drug self-administration model in rodents. In the process, Gabby will learn how to a) use demand analysis to evaluate reward strength, b) write computer programs to control experimental equipment, c) analyze data derived from this type of research, and d) present original research in both written and oral formats.

Mentoring model: We will employ a "junior colleague"/apprenticeship model that is common within the field of psychological research. This includes meeting at least once weekly, and probably more often, as experimental decisions are based on the daily progress of each subject. Data analysis, decision making, and writing will be truly collaborative processes that take place both electronically (e.g., through document exchange over Dropbox) and in person. During the summer, Gabby will be directly engaged with the project on a daily basis through a) running experimental sessions, which will be conducted daily, 5-6 days/week; b) updating data files; and c) animal husbandry (e.g., feeding animals, cleaning cages). She will also work on a third set of revisions for her thesis and begin writing the Results and Discussion sections (Gabby will defend her thesis by the end of Fall 2018).

3. Dissemination plan: We expect to publish the results of this research in a respected, scholarly journal, and to present the results at the annual meeting of the Southeastern Association for Behavior Analysis or of the Association for Behavior Analysis International (or both).

4. Timeline: The timeline for the entire project is as follows:
Response Acquisition: 2 – 3 Weeks
Demand I: 18 – 36 Sessions
Alcohol Self-Administration:14 – 26 Sessions
Demand II: 18 – 36 Sessions
Extinction: Minimum 10 Sessions
Reinstatement Testing: 3 – 6 Sessions

We expect to order animals by the end of March and begin training by the end of April. Conservatively speaking, the entire project should be completed by the second week in September. While this falls outside the window of the MU-MUSE program proper, portions of the project will be complete by the end of summer, and can be presented at the Summer Undergraduate Research Symposium.

References

Banna, K. M., Back, S. E., Do, P. & See, R. E. (2010). Yohimbine stress potentiates conditioned cue-induced reinstatement of heroin-seeking in rats. Behavioral Brain Research, 208(1), 144-148.

Chauvet, C., Lardeux, V., Goldberg, S., Jaber, M., & Solinas, M. (2009). Environmental enrichment reduces cocaine seeking and reinstatement induced by cues and stress but not by cocaine. Neuropsychopharmacology, 34, 2767-2778.

Deehan, G. A. J., Palmatier, M. I., Cain, M. E., & Kiefer, S. W. (2011). Differential rearing conditions and alcohol-preferring rats: Consumption of and operant responding for ethanol. Behavioral Neuroscience, 125(2), 184–193. https://doi.org/10.1037/a0022627

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Hofford, R. S., Darna, M., Wilmouth, C. E., Dwoskin, L. P., & Bardo, M. T. (2014). Environmental enrichment reduces methamphetamine cue-induced reinstatement but does not alter methamphetamine reward or VMAT2 function. Behavioural Brain Research, 270, 151–158. https://doi.org/10.1016/j.bbr.2014.05.007

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Project Abstract (limit to 1,000 characters)

This study seeks to determine the effects of environment on alcohol consumption and relapse in an animal model of alcohol abuse. Sixteen rats will be housed in either an enriched environment (EE) or an environment that is standard to animal laboratories (SE). In the EE condition, rats will be housed in groups of four in large cages with species-appropriate toys, while rats in the SE will be housed individually in smaller cages without toys. Rats will be trained to lever-press for alcohol rewards. Then, the reward strength of alcohol will be assessed using demand analysis both before and after a 2-3 week period of self-administration. Rats will then undergo a period of abstinence and a series of relapse tests. We hypothesize that EE rats will consume less alcohol and demonstrate less relapse behavior than SE rats, and that the reward strength of alcohol will be lower for rats in the EE condition, and will escalate to a lesser degree in these rats following extended self-administration.

Faculty Letter of Endorsement (pdf only)

Any additional documentation? (pdf only)

Any Additional Comments?

Date of Submission
2/19/2018